

Number of Organizations Assigned Patents. The number of organizations in a country that are active in a technology may indicate that country's level of technological capability.⁴¹

Every year since 1995, the United States has had the most organizations actively filing patent applications for Internet business methods. (See figure 6-31 and appendix table 6-18.) During 1997–99, the United States averaged between 100 and 200 active assignees per year, two to four times the number of patenting organizations as Japan, which has ranked second in the number of active patenting organizations every year since 1995 and now has about 50 organizations per year filing priority applications in this technology. Trailing well behind are Germany, Great Britain, and Australia; these countries have between 3 and 10 organizations filing priority applications each year.

Text table 6-9 shows that in every country covered by this study, almost all the assignees are corporations or individual inventors. The United States is the only country in which universities consistently patent Internet business methods.⁴² South Korea and Japan show occasional patenting activity from government agencies in this field. EPO, Finland, and Sweden show less activity from individuals than the other patent offices covered.

Highly Cited Patents. Since 1995, the United States has accounted for about 50 percent of all patent families for Internet business methods but more than 71 percent of the highly cited patent families. (See text table 6-10.) Thus, the United States has about 40 percent more of the highly cited patents in this

field than one would expect based on its overall level of activity. This indicates not only that the United States is generating large numbers of patents in this field but also that these patents have technological significance for those inventions that follow. Unlike the United States, Japan has been significantly underrepresented among the most highly cited patents in this technology relative to its overall level of activity. Although Japan accounts for about 27 percent of all patent families, it accounts for only 6.8 percent of the cited families. One possible explanation for this is that about 85 percent of Japan's patent families are protected only in Japan, and such patents may be less likely to be cited by EPO examiners. Among the other countries that account for at least 2 percent of total patent families in this technology, Germany is significantly overrepresented among the cited patent families with about 50 percent more cited families than would be expected based on its overall level of patenting activity. Canada is significantly underrepresented among the cited patents, and Great Britain has about the number of cited patents expected based on its overall level of activity in this field. Care should be taken not to read too much into the ratios for countries with low levels of activity because one or two highly cited patents from these countries may make them appear to be overrepresented among the highly cited families.

Venture Capital and High-Technology Enterprise

One of the most serious challenges to new entrepreneurs is capital, or the lack thereof. Venture capitalists typically make investments in small, young companies that may not have access to public or credit-oriented institutional funding. Venture capital investments can be long term and high risk, and they may include hands-on involvement in the firm by the venture capitalist. Venture capital can aid the growth of promising small companies and facilitate the introduction of new products and technologies, and it is an important source of funds for the formation and expansion of small high-technology companies. This section examines investments made by U.S. venture capital firms by stage of financing and by technology area.

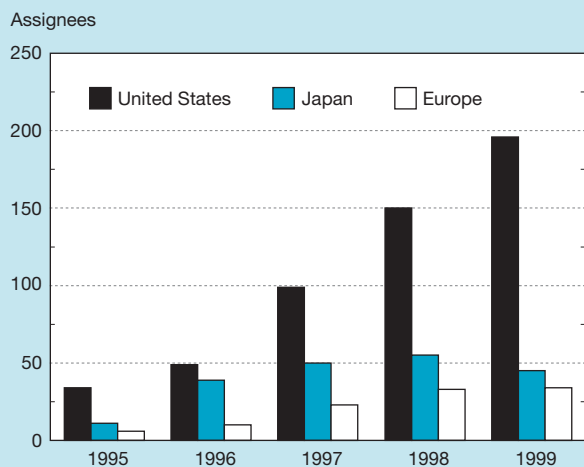
The latest data show total venture capital under management rising vigorously each year from 1996 through 2000. The largest one-year increase occurred in 1999, when the pool of venture capital jumped to nearly \$145.2 billion, a 72.5 percent gain from the previous year. In 2000, once again, the pool of venture capital grew sharply, rising 60.9 percent to \$233.7 billion, more than six times the amount managed only five years earlier.⁴³

The amount of capital managed by venture capital firms grew dramatically during the 1980s as venture capital emerged as an important source of financing for small, innovative firms. (See text table 6-11.) By 1989, the capital managed by venture capital firms totaled nearly \$33.5 billion, up from almost \$4.1 billion in 1980. The number of venture capital firms also grew

⁴¹This refers to the number of unique organizations that have filed patent applications, not the number of applications they have filed. Data for 1999 and 2000 should be considered incomplete because of the 18-month time lag between the date a patent application is filed and the date it is published.

⁴²Like those presented for human DNA sequence patents discussed earlier, data reflect the number of unique organizations filing patent applications, not the number of applications they have filed. Individuals are counted only if no other type of organization also was on the patent.

Figure 6-31.
Active assignees for Internet-related business methods patents, United States, Japan, and Europe



See appendix table 6-18. Science & Engineering Indicators – 2002

⁴³According to a recent report from the National Venture Capital Association (2001), new money coming into venture capital funds slowed down during the last quarter of 2000 following several quarters of lackluster returns to investors in venture capital funds.

Text table 6-9.

Active assignees, by priority country and priority year: Internet-related business methods patents

Priority country	1995	1996	1997	1998	1999	2000
Australia						
Corporations	2	2	3	7	10	0
Universities	0	0	0	0	0	0
Not for profits	0	0	0	0	0	0
Government agencies	0	0	1	0	0	0
Individuals	0	1	2	1	3	0
Canada						
Corporations	1	0	3	5	3	0
Universities	0	0	0	1	0	0
Not for profits	0	0	0	0	0	0
Government agencies	0	0	0	0	0	0
Individuals	3	0	1	3	3	0
Germany						
Corporations	2	2	2	8	10	2
Universities	0	0	0	0	0	0
Not for profits	0	0	1	0	0	0
Government agencies	0	0	0	0	0	0
Individuals	0	1	2	7	7	2
European Patent Office						
Corporations	1	0	2	4	1	0
Universities	0	0	0	0	0	0
Not for profits	0	0	0	0	0	0
Government agencies	0	0	0	0	0	0
Individuals	0	0	1	0	0	0
Finland						
Corporations	1	2	0	3	7	0
Universities	0	0	0	0	0	0
Not for profits	0	0	0	0	0	0
Government agencies	0	0	0	0	0	0
Individuals	0	0	1	0	1	0
France						
Corporations	0	1	3	5	2	0
Universities	0	0	0	0	0	0
Not for profits	0	0	0	0	0	0
Government agencies	0	0	0	0	0	0
Individuals	2	1	1	3	2	0
Great Britain						
Corporations	1	2	7	8	8	1
Universities	0	0	0	0	0	0
Not for profits	0	0	0	0	0	0
Government agencies	0	0	0	0	0	0
Individuals	0	1	1	3	6	0
Japan						
Corporations	11	39	49	54	44	4
Universities	0	0	0	0	0	0
Not for profits	0	0	0	0	0	0
Government agencies	0	0	0	1	1	0
Individuals	0	7	5	5	7	1
South Korea						
Corporations	2	1	3	4	0	0
Universities	0	0	0	0	0	0
Not for profits	0	0	0	0	0	0
Government agencies	1	0	1	1	0	0
Individuals	1	0	0	2	10	0
Sweden						
Corporations	0	1	6	2	2	0
Universities	0	0	0	0	0	0
Not for profits	0	0	0	0	0	0
Government agencies	0	0	0	0	0	0
Individuals	0	0	0	2	0	0
United States						
Corporations	33	47	98	148	195	1
Universities	1	1	1	2	1	0
Not for profits	0	1	0	0	0	0
Government agencies						
Individuals	8	22	47	34	33	0
Other						
Corporations	2	3	7	21	13	2
Universities	0	2	0	0	0	0
Not for profits	0	1	0	1	0	0
Government agencies						
Individuals	3	1	10	13	13	4

NOTE: Priority country is established by the location of the original patent application.

SOURCE: "International Analysis of Internet-Related Business Methods Patenting," submitted to National Science Foundation by Mogue Research and Analysis Associates (Reston, VA, June 7, 2001).

Text table 6-10.

Priority countries ranked by share of top-cited patents: Internet-related business methods, 1995-99

Priority country	Share of top cited (%)	Share of total families (%)	Ratio top cited to total families
United States	71.2	50.3	1.4
Japan	6.8	27.1	0.3
Germany	5.5	3.6	1.5
Finland	4.1	0.9	4.4
European Patent Office	2.7	0.9	2.9
Great Britain	2.7	3.0	0.9
Australia	1.4	2.2	0.6
Canada	1.4	1.4	1.0
Denmark	1.4	0.1	11.2
Ireland	1.4	0.4	3.7
Netherlands	1.4	0.9	1.6

NOTE: Priority country is established by the location of the original patent application.

SOURCE: "International Analysis of Internet-Related Business Methods Patenting," submitted to National Science Foundation by Mogue Research and Analysis Associates (Reston, VA, June 7, 2001).

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Text table 6-11.

Venture capital under management in United States: 1980-2000

(Millions of U.S. dollars)

Year	New capital committed	Total venture capital under management
1980	2,073.6	4,071.1
1981	1,133.2	5,685.7
1982	1,546.4	7,758.7
1983	4,120.4	12,201.2
1984	3,048.5	15,759.3
1985	3,040.0	19,330.6
1986	3,613.1	23,371.4
1987	4,023.9	26,998.5
1988	3,491.9	29,539.2
1989	5,197.6	33,466.9
1990	2,550.4	34,000.9
1991	1,488.0	31,587.2
1992	3,392.8	30,557.3
1993	4,115.3	31,894.0
1994	7,339.4	34,841.3
1995	8,426.7	38,465.0
1996	10,467.2	46,207.2
1997	15,175.6	59,614.5
1998	25,292.6	84,180.1
1999	60,138.4	145,195.6
2000	93,436.1	233,666.1

SOURCE: Special tabulations provided by Venture Economics (Newark, NJ, March 2001).

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during the 1980s from around 448 in 1983 to 670 in 1989.

In the early 1990s, the venture capital industry slowed as investor interest waned and the amount of venture capital disbursed to companies declined. The number of firms managing venture capital also declined during the early 1990s. The slowdown was short lived, however; investor interest picked up in 1992 and the pool of venture capital has grown steadily since then.

California, New York, and Massachusetts together account for about 65 percent of venture capital resources. Venture capital firms tend to cluster around locales considered to be hotbeds of technological activity as well as in states where large amounts of R&D are performed (Venture Economics Information Services (VEIS) 1999).⁴⁴ See sidebar, "Business Incubators Nurture Future Entrepreneurs on U.S. Campuses."

Venture Capital Commitments and Disbursements

Several years of high returns on venture capital investments have stimulated increased investor interest. This interest soared after 1995, with new commitments rising 24.2 percent in 1996 to nearly \$10.5 billion and then rising 45.0 percent the following year. By 2000, new commitments reached \$93.4 billion, more than 10 times the amount available in 1995. Pension funds remain the single largest supplier of committed capital, supplying 41 percent in 2000. (See text table 6-12.) Banks and insurance companies are the next largest source, supplying 23 percent of committed capital, followed closely by endowments and foundations at 21 percent (VEIS 1999).⁴⁵

Starting in 1994, new capital raised exceeded capital disbursed by the venture capital industry. In each of the following years, that gap has grown larger, creating surplus funds available for investments in new or expanding innovative firms. As early as 1990, firms producing computer software or providing computer-related services received large amounts of new venture capital, but they became the clear favorite beginning in 1996. (See figure 6-32 and appendix table 6-19.) In 1990, software companies received 17.4 percent of all new venture capital disbursements, nearly twice the share going to computer hardware companies and biotechnology companies. That share rose to about 27.1 percent in 1993 and then fluctuated between 16.4 and 27.1 percent until 1998, when software companies received more than one-third of all venture capital disbursements. Telecommunications companies also attracted large amounts of venture capital during the 1990s, edging out software companies for the lead in 1992 and 1994. Medical and health care companies received a large share of venture capital throughout the 1990s, reaching a high of 17.8 percent in 1994 before dropping to 13.6 percent in 1998. Computer hardware companies, an industry highly favored by the venture capitalists during the 1980s, received only 2.4 percent of total venture capital disbursements in 2000.

The latest data include a new category that makes comparisons with previous years more difficult. In the late 1990s, the Internet emerged as a key new tool for business, and com-

⁴⁴Data on U.S. R&D performance by state are presented in chapter 4.

⁴⁵Based on information contained in Venture Economics (1999).

Text table 6-12.

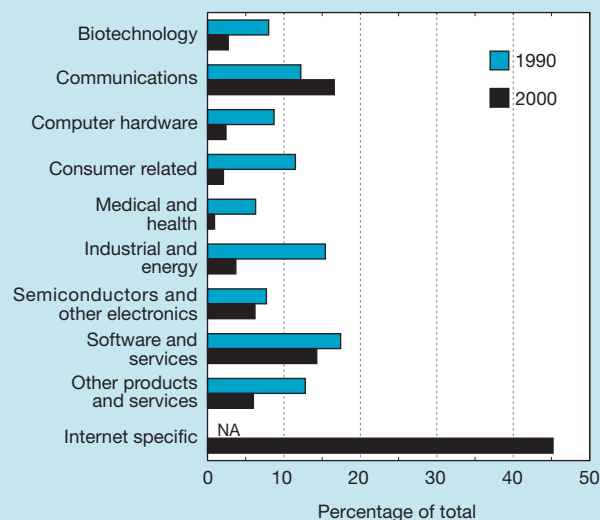
Capital commitments by limited partner type: 1990–2000
(Billions of dollars)

Limited partner type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total commitment ...	2.55	1.49	3.39	4.12	7.34	8.43	10.47	15.18	25.29	60.14	93.44
Pension funds	1.34	0.63	1.41	2.43	3.36	3.12	5.74	5.77	15.03	26.16	37.47
Financial and insurance	0.24	0.08	0.49	0.43	0.70	1.62	0.30	0.91	2.59	9.32	21.77
Endowments and foundations	0.32	0.36	0.63	0.44	1.57	1.65	1.18	2.43	1.58	10.34	19.72
Individuals and families	0.29	0.18	0.37	0.30	0.87	1.36	0.68	1.82	2.83	5.77	11.03
Corporations	0.17	0.06	0.11	0.34	0.67	0.35	1.98	3.64	2.97	8.54	3.46
Foreign investors	0.19	0.17	0.38	0.18	0.18	0.32	0.59	0.61	0.29	NA	NA

NA = not available

SOURCE: Special tabulations provided by Venture Economics (Newark, NJ, March 2001).

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Figure 6-32.
U.S. venture capital disbursements, by industry category

NA = not available

See appendix table 6-19. Science & Engineering Indicators – 2002

panies developing Internet-related technologies drew venture capital investments in record amounts. Beginning in 1999, investment dollars disbursed to Internet companies were classified separately in the statistics that track venture capital investment trends. Before 1999, some of these investments would have been classified as going to companies involved in computer hardware, computer software, or communications technologies.

In 1999, Internet companies became the leading recipients of venture capital funds, collecting 41.7 percent of all venture capital disbursed. The latest data show their share increasing to 45.2 percent in 2000. Computer software companies, the leader through much of the 1990s, drew 12.9 per-

cent of all venture capital disbursed in 1999 and 14.3 percent in 2000. The share of investments going to communications companies averaged 16.5 percent in 1999 and 2000.

Venture Capital Investments by Stage of Financing

The investments made by venture capital firms may be categorized by the stage at which the financing is provided (VEIS 1999). Early-stage financing involves the following:

- ◆ **Seed financing**—usually involves a small amount of capital provided to an inventor or entrepreneur to prove a concept. Seed financing may support product development but rarely is used for marketing.
- ◆ **Startup financing**—provides funds to companies for use in product development and initial marketing. This type of financing usually is provided to companies that are newly organized or have been in business for a short time and have not yet sold their product in the marketplace. Generally, such firms have already assembled key management, prepared a business plan, and conducted market studies.
- ◆ **First-stage financing**—provides funds to companies that have exhausted their initial capital and need funds to initiate commercial manufacturing and sales.

Later stage financing includes the following:

- ◆ **Expansion financing**—includes working capital for the initial expansion of a company; funds for major growth expansion (involving plant expansion, marketing, or development of an improved product); and financing for a company expecting to go public within six months to a year.
- ◆ **Acquisition financing**—provides funds to finance the purchase of another company.

◆ **Management/leveraged buyout**—includes funds to enable operating management to acquire a product line or business from either a public or private company. These companies often are closely held or family owned.⁴⁶

Most venture capital disbursements are directed to later stage investments. Since 1982, later stage investments captured between 59 and 79 percent of venture capital disburse-

⁴⁶For the acquisition financing and management/leveraged buyout categories, data include only capital disbursements made by a venture capital firm and do not include such investments made by a buyout firm.

Business Incubators Nurture Future Entrepreneurs on U.S. Campuses

The term “business incubator” can describe a wide range of institutions whose purpose is to help develop new and nurture established small business enterprises. According to data compiled by the National Business Incubation Association (NBIA), in 1980 as few as 12 business incubators were operating in North America; in 1998, there were more than 800 (National Business Incubation Association 2001).

Business incubators can be operated by universities, colleges and community colleges, for-profit businesses and economic development agencies, local governments, or a combination of all these organizations. Business incubators seek to encourage new entrepreneurs by consolidating, usually under one roof, many of the services critical to successful business development, including management advice, networking with other business owners, technical support, and access to financing.

In 1998, according to data compiled by NBIA:

- ◆ 40 percent of incubators were technology focused.
- ◆ 45 percent were urban, 36 percent were rural, and 19 percent were suburban.
- ◆ 27 percent were affiliated with universities and colleges either directly or as part of joint efforts among governments, private developers, and non-profit agencies.

More than half of all incubators operating in 1998 were sponsored by government and nonprofit organizations. These incubators tend to focus on local economic development and job creation. Such “targeted” incubators accounted for about 9 percent of the total in 1998.

Data on numbers and characteristics of business incubators operating in the United States come from NBIA’s website. The NBIA database offers the most current and complete data available but, according to its own estimates, likely understates the numbers of business incubators operating in 1998.

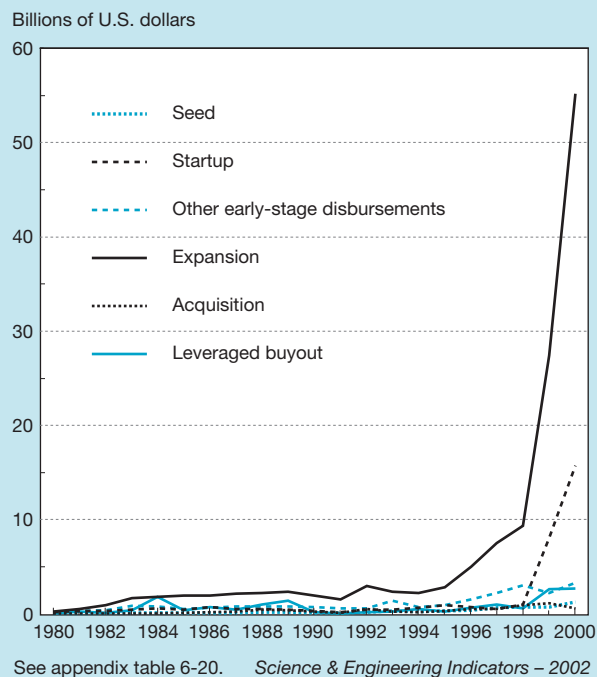
ments, with the high and low points both reached in the 1990s. In 2000, later stage investments represented 78 percent of total disbursements. (See figure 6-33 and appendix table 6-20.) Capital for company expansions attracted the most investor interest by far; this financing stage alone attracted more than half of all venture capital disbursed since 1995. In 2000, venture capital funds to finance company expansions accounted for 61 percent of total disbursements. Nearly half (48.1 percent) of the \$55.2 billion disbursed by venture capital funds to finance expansions of existing businesses in 2000 went to Internet companies.

Contrary to expectations, only a relatively small amount of venture capital helps struggling inventors or entrepreneurs prove a concept or develop their products. During the 21-year period examined, such seed money never accounted for more than 6 percent of all venture capital disbursements and most often represented between 2 and 4 percent of the annual totals.⁴⁷ The latest data show the share of all venture capital disbursements classified as seed financing falling to its lowest level ever, representing just 1.4 percent of all venture capital in both 1999 and 2000. Nevertheless, nearly \$1.3 billion in seed money was disbursed by venture capital funds in 2000, up from \$710.7 million in 1999 and \$312.5 million in 1995.

Computer software, telecommunications technologies, and medical and health-related firms were the largest recipients of venture capital seed-type financing during the late 1990s.

⁴⁷A study of new firms in the southwestern United States found that many were able to obtain substantial amounts of initial capital through strategic alliances with more established firms (Carayannis, Kassicieh, and Radosevich 1997). The study indicated that embryonic firms raised more than \$2 million, on average, in early-stage financing through such strategic alliances.

Figure 6-33.
U.S. venture capital disbursements, by stage of financing, 1980–2000



(See appendix table 6-21.) Computer software firms received the most seed money from 1996 to 1998 before relinquishing the top position to Internet companies in 1999 and 2000. Investments in Internet companies represented 60.8 percent of all seed money from venture capital funds in 1999 and 43.7 percent in 2000.

Communications firms gained favor with forward-looking venture capitalists in 2000, attracting 26.2 percent of all seed-stage investments disbursed by venture capital funds that year, up from just 5.0 percent in 1999. The shares of venture capital seed money going to computer software companies fell to 11.3 percent in 1999 and to 10.5 percent in 2000.

With more than 80 percent of seed money going to either Internet, communications, or computer software companies, seed money for companies involved in other technologies declined. Biotechnology, which in 1998 received 11.9 percent of the venture capital disbursed as seed money, saw its share drop to 6.3 percent in 1999 and 0.9 percent in 2000. Medical and health-related firms fared better than biotechnology firms, yet they saw their share drop from 20 percent in both 1997 and 1998 to 6.9 percent in 1999 and 2.9 percent in 2000.

Chapter Summary: Assessment of U.S. Technological Competitiveness

Based on various indicators of technology development and market competitiveness, the United States continues to lead, or to be among the leaders, in all major technology areas. Advances in information technologies (i.e., computers and telecommunications products) continue to influence new technology development and dominate technical exchanges between the United States and its trading partners.

Although economic problems continue to hamper further progress, Asia's status as both a consumer and developer of high-technology products is enhanced by the development taking place in many Asian economies, particularly Taiwan and South Korea. Several smaller European countries also exhibit growing capacities to develop new technologies and to compete in global markets.

The current position of the United States as the world's leading producer of high-technology products reflects its success in both supplying a large domestic market and serving foreign markets. This success in the international marketplace may be the result of a combination of factors: the nation's long commitment to investments in S&T; the scale effects derived from serving a large, demanding domestic market; and the U.S. market's openness to foreign competition. In the years ahead, these same market dynamics may also benefit a more unified Europe and Latin America and a rapidly developing Asia and complement their investments in S&T.

Beyond these challenges, the rapid technological development taking place around the world also offers new opportunities for the U.S. S&T enterprise. For U.S. businesses, rising exports of high-technology products and services to Asia, Europe, and Latin America are already apparent and should grow in the years ahead. The same conditions that create new

business opportunities—the growing global technological capacity and the relaxation of restrictions on international business—can also create new research opportunities. The well-funded institutes and technology-oriented universities that are being established in many technologically emerging areas of the world will advance scientific and technological knowledge and lead to new collaborations between U.S. and foreign researchers.

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